

To the President  
of the Royal College of Surgeons  
London --



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ON THE

# PRIMUM MOBILE

OF

THE BLOOD IN THE LUNGS AT BIRTH;

ITS COMPLETE

VITALIZATION OR ANIMALIZATION;

AND

ITS SUBSEQUENT CIRCULATION.

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BY WILLIAM SHERWIN,

M.R.C.S., of LONDON.

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## REMARKS.

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The human body may be represented as composed of innumerable pipes and tubes, infinitely minute, and containing fluid, of small cells and larger cavities, all air-tight ; and all contained in one great air-tight sac—the skin.

The chest is divided into three air-tight cavities, containing, in the right and left cavities, the lungs ; in the centre cavity the heart.

The lungs communicate with, and are distended by the air through the wind-pipe, which is composed of incomplete cartilagenous rings, united by membrane, always open, and becomes wholly membranous and *more and more elastic* as it advances and sub-divides in the lungs, until it is so completely attenuated that it is scarcely visible.

The heart is a hollow\* double viscus, has no connection with the external air, and consists of a right auricle and ventricle, and a left auricle and ventricle, and each auricle and ventricle have direct communication with each other by an aperture.

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\* The heart being a hollow muscle, dilates by a peculiar power dependent on its organic structure, and dilatation *may* be only relaxation to such muscles, and the terms dilatation and relaxation are synonymous when speaking of the heart.

The lungs, the heart, and the whole of the body communicate freely with each other by means of air-tight tubes and pipes, called blood-vessels.

The blood-vessels consist of arteries and veins.

The arteries are tubes proceeding from the heart to the capillaries of the lungs and system generally, and have *no valves* except at their exit from the heart.

The veins are also tubes, and are supplied with *valves* through their whole course; and proceed from the capillaries of the lungs, and of the system generally to the heart.

The lungs in the fœtus are dense and firm

The heart in the fœtus is *single*, the auricles being connected by the *foramen ovale*, the ventricles by the *ductus arteriosus*.

Respiration is the act of breathing, commences at birth, and consists of Inspiration and Expiration.

Inspiration (ordinary) is performed principally by the contraction of the diaphragm, and the intercostal muscles, which dilate the chest.

Expiration (ordinary) is performed principally by the relaxation of the diaphragm and the intercostal muscles, aided by the elasticity of the cartilages of the ribs and sternum, and the *elasticity* of the lungs, and by contraction of the oblique, transverse, pyramidal and rectus muscles of the abdomen, which contract the chest,\* &c.

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\* Expiratory muscles aid the abdominal circulation by pressing on the several abdominal viscera, &c., and contract when the inspiratory muscles relax—that is, just at the moment when the right auricle dilates and sucks in the abdominal venous blood along the *venæ cavae*.

## THE FIRST INSPIRATION.

When the new-born infant first inspires, air rushes into the lungs though the windpipe and distends the lungs, producing a *new and increased area* for the blood, without *increasing its quantity*.

## EXPIRATION.

Expiration follows—the inspired air is pressed out of the lungs, (these attempt to revert to their collapsed fœtal state, indeed to form a vacuum,) blood rushes into their capillary vessels through the pulmonary\* artery, (the blood is diverted from the aorta† by the *suction* of the lungs, in their attempt to collapse) empties the right ventricle,‡ (this contracts at the same moment, excited thereto by the stimulus of the movement of the blood,) the right ventricle by relaxation or dilatation, sucks in the blood from the right auricle,|| the right auricle, by a similar action, takes the blood from the *venæ cavæ*§ and systemic capillaries—this venous circulation being further aided by atmospheric pressure.

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\* Pulmonary artery supplied with valves to prevent regurgitation of blood from the lungs in inspiration, and also to prevent regurgitation of blood into right ventricle when it dilates.

† Now the *ductus arteriosus* closes.

‡ Right ventricle supplied with valves to prevent regurgitation of blood into auricle when the ventricle contracts.

|| No valves. The contractile power of the auricles appears to be very trifling. It may therefore be presumed that they act as reservoirs to the blood for the ventricles, and also to receive the retrograde blood when the ventricles contract. The reticulations in the right auricle are doubtless to thoroughly mix the circulating fluid before it is submitted to be oxygenized in the lungs.

§ *Venæ cavæ* have muscular fibres, probably to counteract the effect of the atmospheric pressure forcing, and the ventricle sucking, the blood through the auricle with too great force, or to resist retrograde motion of blood produced by contraction of auricle.



## SECOND INSPIRATION.

Inspiration takes place, the lungs (the capillaries\* of which now possess blood,) are again forcibly distended by air which mechanically presses the blood out of the pulmonary capillaries along the pulmonary† veins to the left auricle‡ (now a distinct cavity by closing of *foramen ovale*,)|| the blood is then sucked into, by dilatation of the left ventricle, (the auricle contracts at the same moment,) and is propelled thence by con-

\* It is not to be understood that the whole of the blood passes out of the capillaries of the lungs at each inspiration, but only that portion of it which has become *oxygenized*, when the same, or about the same, quantity passes through the systemic capillaries, having been *deoxygenized*. Nor is it either to be understood that at the first expiration the whole of the blood is drawn into the lungs at once, but only gradually, as the pulmonary capillaries become developed for its reception, when the quantity of blood in the pulmonary capillaries is probably the same as in the systemic capillaries; and it is also probable that neither of these capillary systems are ever even nearly emptied, but that they are reservoirs in which the blood is retarded; and as no quantity of homogeneous fluid so circumstanced can be in a state of rest, it follows that every globule of the circulating fluid is subjected to a particular action in the capillaries of the lungs, and also in the systemic capillaries—in the one system (pulmonary) for the purpose of being oxygenized or vitalized, in the other system (systemic) to be deoxygenized or to impart nutriment to the several component parts of the body—thus the two systems are always acting in unison—the one receiving, the other distributing.

† Pulmonary veins furnished with muscular fibres to prevent too great an influx of blood to the auricle when it dilates in inspiration, or retrorgrade motion of blood when the auricle contracts in expiration.

‡ Left auricle, no valves.

|| The *foramen ovale* is closed by its semilunar valve being pressed down when circulation takes place in the pulmonary veins, and its floating margin extended by flocculi, as I have observed in the hearts of lambs, forming two distinct auricles; the heart becomes two or doubled—the right with its vessels to propel the blood to, and convey it from, the lungs; the left with its vessels to propel the blood to, and convey it from, the system generally; both auricles continue to contract and dilate simultaneously (the same of the ventricles) as they did in the fetal state.



traction of left\* ventricle, through the aorta† to the systemic capillaries.

## RECAPITULATION.

Pulmonary arterial circulation is performed by the contraction of the right ventricle, and by expiration ; and pulmonary venous circulation, by inspiration, and by dilatation of the left auricle and ventricle—and

Systemic arterial circulation, is performed by the contraction of the left ventricle, and is aided by the increasing area of the arteries from their origin at the heart to their termination in the capillaries. Therefore, on opening an artery near the heart, the blood will pass out by *jerks*, but as it advances towards the capillaries, the area at length becomes so much increased, and the velocity of the blood consequently so much diminished, that this appearance is no longer perceptible, and the blood has even been said, (though very erroneously,) to cease to flow in the capillaries. These vessels, (the systemic capillaries and arteries,) being full of blood and the valve of the aorta being closed, prevents the blood from regurgitating when the atmospheric pressure commences on the capillaries of the veins—the auricle being at the same time dilated, the double power of suction of auricle and of atmospheric pressure is applied to the venous circulation, consequently upon opening a vein the blood will flow in a continued stream, and will increase in velocity

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\* Left ventricle supplied with valves to prevent regurgitation of blood into auricle when the ventricle contracts.

† Aorta supplied with valves to prevent return of blood to ventricle when it dilates, and to counteract the pressure of the atmosphere on the systemic capillaries.

the nearer it approaches the heart, the area of the veins diminishing (being the reverse of the arteries) from the capillaries to the heart.

The use of the numerous valves in the course of the veins, and the reason of the superficial position of these vessels, is now apparent; and the reason of the absence of valves in the course of the arteries, and their deep seated position, and the use (though this is not the only use) of the valve in the aorta at its exit from the heart, is not less evident; and the whole of this wonderful and elaborate system of mechanism is evidence of design and forethought in suiting the means to the end intended by our GREAT ORIGINATOR.

The "*Primum Mobile*" of the blood in the lungs at birth is, then, the result of *Expiration*; its complete "*Vitalization\* or Animalization*," is the effect of *Inspiration*; and its "*Circulation*," is the result of the combined actions of *Respiration, and contraction and dilatation or relaxation of the heart, aided by the circumambient pressure of the atmosphere*, upon the principles of *Hydrodynamics*.

\* The nervous system of fœtuses that have not yet breathed does not seem sensible to the action of poisons.—(*Magendie*, 394.) Nor have the veins or arteries at any time any feeling.—(*Bichat*, 221, 222, 228.) No organ continues to act without receiving arterial blood.—(*Magendie*, 336.) Brain nor nerves not called into full action till breathing takes place.—(*Bichat*, 221—6.

\* 1 Gen. c. ii, v. 7.

\* Deuty.c. xii, v. 23.